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- (71) Applicants (for all designated States except US): UNIVERSITY OF GEORGIA RESEARCH FOUN-DATION, INC. [US/US]; 624 Boyd Graduate Studies Research Center, Athens, GA 30602-7411 (US). THE OHIO STATE UNIVERSITY [US/US]; 1960 Kennedy Road, Columbus, OH 43065 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): MAIER, Robert, J. [US/US]; 1040 Blue Beech Pointe, Athens, GA 30606 (US). GUNN, John, S. [US/US]; 266 Oakham Court, Powell, OH 43065 (US).
- (74) Agent: ADDISON, Bradford, G.; Barnes & Thornburg LLP, 11 South Meridian Street, Indianapolis, IN 46204 (US).

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(57) Abstract: The present disclosure describes pathogenic bacteria that have been modified to be deficient in NiFe hydrogenase activity; compositions comprising such modified bacteria, and the use of such bacteria to protect animals from pathogenic enteric bacterial infections.